

**REMARKS**

The specification and claims have been amended to correct grammatical errors and to employ more idiomatic English. A Replacement Specification and marked copy of same accompany this Amendment. The title of the invention has been amended, as suggested by the Examiner.

Claims 1 and 10 have been amended to more clearly distinguish the invention over the art, and claims 5 and 14 have been amended to conform with claims 1 and 10. New claims 19-22 correspond essentially to original claims 2, 3, 11 and 12 rewritten in independent form.

No new matter has been entered by any of the foregoing amendments.

Turning to the Examiner's rejections under 35 USC §103 of: claims 1, 8 and 9 as obvious over Keiji (JP Publication No. 09-093470) in view of Hidekage (JP Publication No. 08-125924); claims 4 and 5 as obvious over Keiji in view of Hidekage in further view of Azim (U.S. Patent No. 6,137,533); claims 6 and 7 in view of Hidekage in further view of Azim and Lee (U.S. Patent No. 5,301,026); claims 10, 17 and 18 as obvious over Keiji in view of Nishikawa (U.S. Patent No. 4,566,074); claims 13 and 14 as obvious over Keiji in view of Nishikawa in further view of Azim; and claims 15 and 16 as obvious over Keiji in view of Nishikawa in further view of Azim and Lee, claims 1 and 10 have been amended to specify that the signal processing bit number is variable, and that the processing bit number is set by a digital signal processor from a bit number converting signal received from a system controller. None of the above references teaches this feature. Keiji teaches a DSP that receives a signal from a clock circuit via a frequency divider (FIG. 1). Hidekage is only concerned with A/D conversion (Abstract).

Lee teaches a picture editing apparatus for a digital still video camera system in which digital video signals are recorded on a memory card. And, Nishikawa teaches "... using an A/D converter having as small a quantity bit number as possible to lower the cost." (Col. 3, lines 33-38).

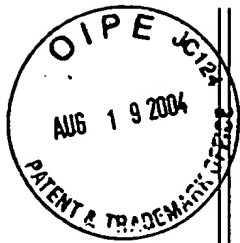
As for Azim, the Examiner contends in cipher 3, page 5 of the Action that Azim "... discloses an image capturing device with a digital signal processor that receives a digital video signal from the A/D converter that can either have a quantization bit number of 12 bits, when a digital gain is applied, or 10 bits." And, "it is implied the system controller sends a signal to the DSP whether or not to use the compander." (cipher 3, page 5). However, nowhere does Azim disclose a system controller that communicates with a DSP or a compander (FIG. 1). Thus, no combination of Keiji, Hidekage, Azim, Lee and Nishikawa could achieve or render obvious Applicant's claims 1 and 10, nor any claims dependent therefrom.

The indicated allowability of claims 2, 3, 11 and 12 is noted, with thanks. These claims have been rewritten as new claims 19-22, respectively.

Having dealt with all the objections raised by the Examiner, the Application is believed to be in order for allowance. Early and favorable action are respectfully requested.

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Serial No. 09/707,815  
Docket No. NEC DP-689  
Amendment A

A credit card authorization Form PTO-2038 in the amount of \$294.00 to cover the costs of additional claims (two dependent (\$36.00) and three independent (\$258.00)) is enclosed. In the event there are any fee deficiencies or additional fees are payable, please charge them (or credit any overpayment) to our Deposit Account Number 08-1391.

Respectfully submitted,

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SERIAL NO. 09/707,815

DOCKET: NEC DP-689

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**REPLACEMENT SPECIFICATION**

(Submitted with Amendment A)



Serial No. 09/707,815  
Docket No. NEC DP-689  
Submitted with Amendment A

## MARKED REPLACEMENT SPECIFICATION

### IMAGE TAKING APPARATUS WITH AN A/D CONVERTER AND DSP WITH VARIABLE QUANTIZATION BIT NUMBERS

5

#### BACKGROUND OF THE INVENTION

The present invention relates to an image taking apparatus that displays an image  
10 taken by a solid state image taking device on a display, in particular, in which the power  
consumption of the total system of the image taking apparatus is reduced at the time when a  
monitoring image is displayed on the display.

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#### Description of the Related Art

15 Among image taking apparatuses, an electronic still camera, which displays an image  
taken by a solid state image taking device such as a charge coupled device (CCD) on a displaying  
apparatus such as a liquid crystal display (LCD) as a monitoring image, and also in which the  
image is recorded in a recording medium such as a floppy disk or a memory card, has been rapidly  
and widely used in the market.

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20 At the solid state image taking device used in the electronic still camera, a CCD  
having more than 2 million pixels has been now used mainly instead of the CCD having about 1.3  
million pixels, and an electronic still camera provided a CCD having a large number of pixels has  
been rapidly developed.

25 The reasons why the electronic still camera provided the CCD having a large number  
of pixels has been widely developed are explained below. First, the cost of the solid state image  
taking device has ~~been~~ decreased. Secondly, the performance of central processing unit (CPU) has  
~~been~~ improved rapidly as represented in Pentium CPU, and the large number of data has been  
processed easily at a consumer use personal computer (PC) by that the recording medium has  
~~become~~ large capacity. In this, the Pentium is a registered trademark of Intel Corp. And Also, a

high definition image being more than a video graphics array (VGA) class image, used mainly in a few years ago, has been required by users. ~~In this, the Pentium is a registered trademark of Intel Corp.~~

In the near future, the electronic still camera will use a solid state image taking device  
5 having larger pixels, and will become a multi function, and will be used for various purposes. However, the power consumption of the total system of the electronic still camera will be increased because of the larger number of pixels and the multi function.

In case that the number of pixels is increased, the electrode capacity of the solid state image taking device is increased. And the driving frequency of the solid state image taking device  
10 may also increase in proportion to the increase of the number of pixels.

As a result, the power consumption of a driving circuit for driving the solid state image taking device is increased, and the operating frequency of the total system of the electronic still camera is also increased, therefore, the power consumption of the total system of the electronic still camera is increased.

15 Further, corresponding to the multi function of the electronic still camera, in addition to the displaying apparatus and the recording medium mentioned above, a TV set and/or a PC is connected to the total system of the electronic still camera. With this additional connection, the power consumption of the total system of the electronic still camera will be increased.

Consequently, the life of a battery being a power source is decreased, and the shooting  
20 time is forced to decrease and the number of recording images is forced to decrease. Therefore, even the multi function of the electronic still camera is achieved, the multi function can not be used sufficiently.

Therefore, at the development of the electronic still camera, in which the performance and the functions of the electronic still camera must be studied, it is also very important to reduce  
25 the power consumption of the total system of the electronic still camera. At the electronic still camera, the number of times displaying images such as monitoring images on the LCD is large,

and further, the power consumption of the LCD is large. Therefore, in order to reduce the power consumption of the total system, it is very effective that the power consumption of the total system is decreased at the time when the image is displayed on the LCD.

5 In order to solve the problem mentioned above, various technologies, in which the power consumption of the total system is decreased at the time when the image is displayed on the LCD, have been disclosed. For example, these technologies are disclosed in Japanese Patent Applications Laid-Open No. HEI 11-164178, HEI 11-136551, HEI 10-276356, and HEI 9-93470.

10 These conventional technologies, in which the power consumption of the total system of the electronic still camera at the time displaying the image on the LCD is reduced, are explained.

First, the electronic still camera disclosed in the Japanese Patent Application Laid-Open No. HEL 11-164178 is explained. Fig. 1 is a block diagram showing a structure of the conventional electronic still camera disclosed in the Japanese Patent Application Laid-Open No. HEI 11- 164178.

15 As shown in Fig. 1, the conventional electronic still camera consists of an image taking circuit 501, a signal processor 502, a compression/expansion circuit 503, an image information memory 504, a CPU 505, a compression rate setting switch 506, an amount of light controlling circuit 507, a brightness adjusting volume 508, an LCD monitor 509, and a back-light 510.

20 At this conventional electronic still camera, the compression rate of image data of an image to be taken at the image taking circuit 501 is set beforehand at the compression rate setting switch 506. After this setting, the image data are started to take at the image taking circuit 501. In this, the compression rate of the image data corresponds to the image quality of the image, the higher the compression rate is, the worse the image quality of the image is.

25 The image taking circuit 501 takes image data and outputs the image data to the signal processor 502. The signal processor 502 converts the image data outputted from the image taking

circuit 501 to image data for displaying on the LCD monitor 509 and outputs the converted image data.

The compression/expansion circuit 503 compresses the image data outputted from the signal processor 502 by the compression rate set at the compression rate setting switch 506. The  
5 image information memory 504 stores the image data compressed at the compression/expansion circuit 503.

The amount of light controlling circuit 507, in case that the image data stored in the image information memory 504 is reproduced and displayed on the LCD monitor 509, controls the amount of light of the back-light 510 for the LCD monitor 509 based on the compression rate of  
10 the image data stored in the image information memory 504. The brightness adjusting volume 508 adjusts the amount of light controlling circuit 507 finely.

The CPU 505 controls the signal processor 502, the compression/expansion circuit 503, the amount of light controlling circuit 507, and the brightness adjusting volume 508.

At this conventional electronic still camera having the structure mentioned above, in  
15 case that the image data stored in the image information memory 504 is compressed by a compression rate that is lower than a normal compression rate, the amount of light controlling circuit 507 controls so that the amount of light of the back-light 510 becomes lighter than normal light. And in case that the image data stored in the image information memory 504 is compressed by a compression rate that is higher than the normal compression rate, the amount of light  
20 controlling circuit 507 controls so that the amount of light of the back-light 510 becomes darker than the normal light.

That is, at this conventional electronic still camera, in case that an image data whose image quality is low is displayed on the LCD monitor 509, the amount of light of the back-light 510 is controlled to be darker than the normal light. With this, the power consumption of the total  
25 system is reduced.



Next, the electronic still camera disclosed in the Japanese Patent Application Laid-Open No. HEI 11-136551 is explained. Fig. 2 is a block diagram showing a structure of the conventional electronic still camera disclosed in the Japanese Patent Application Laid-Open No. HEI 11- 13655 1.

5           As shown in Fig. 2, this conventional electronic still camera consists of a camera 601, an LCD 602, a back-light 603 for the LCD 602, a controller 604 for controlling the amount of light of the back-light 603, input switches 608, 609, and 610 for setting conditions at taking or reproducing images, a sensor 607 for sensing the inputted state of the input switches 608, 609, and 610, a timer 606 that starts counting from the time when any of the input switches 608, 609, and 10. 610 is inputted base on the sensed result of the sensor 607, a memory 605 for memorizing the amount of light of the back-light 603, a setting display panel 611 for displaying the setting conditions at the taking or reproducing images base on the inputted state of the input switches 608, 609, and 610, and a power source 612. In this, the LCD 602 is disposed in the camera 601.

          At this conventional electronic still camera having the structure mentioned above, in 15 case that it is judged that a photographer is operating the input switches 608, 609, and 610 base on the counted number at the timer 606, the controller 604 judges that the photographer is not watching the LCD 602 attentively, and controls so that the amount of light of the back-light 603 for the LCD 602 becomes dark.

          That is, at this conventional electronic still camera, when the image is displayed on 20 the LCD 602, in case that the photographer is setting the conditions at taking or reproducing images, the amount of the back-light 603 is controlled to become dark. With this, the power consumption of the total system is reduced.

          Next, the electronic still camera disclosed in the Japanese Patent Application Laid-Open No. HEI 10-276356 is explained. Fig. 3 is a block diagram showing a structure of the 25 conventional electronic still camera disclosed in the Japanese Patent Application Laid-Open No. HEI 10-276356.

As shown in Fig. 3, this conventional electronic still camera consists of an image taking section 702 which converts an optical image of a subject to be taken to image data and outputs the converted image data, a capture memory 703 which stores the image data outputted from the image taking section 702 temporarily, a displaying section 704 which provides a LCD 741 that displays the image data stored in the capture memory 703, and a controller 701 which controls the image data to be displayed on the LCD 741.

The image taking section 702 consists of a CCD 721 which converts an optical image of a subject to be taken to image data and outputs the converted image data to the capture memory 703, and a CCD controller 722 which drives the CCD 721.

The controller 701 consists of an exposure controller 711 which calculates an exposure based on the brightness of the image data stored in the capture memory 703 and sets a shutter speed to the CCD controller 722 in the image taking section 702 based on this calculated result, an LCD brightness controller 712 which sets the brightness of the LCD 741 based on the calculated result at the exposure controller 711, and an LCD display controller 713 which converts the image data stored in the capture memory 703 to image data to be displayed on the LCD 741 and outputs the converted image data to the displaying section 704.

The displaying section 704 consists of the LCD 741, and an LCD controller 742 which controls the LCD 741 based on the brightness set at the LCD brightness controller 712 and the image data outputted from the LCD display controller 713.

At this conventional electronic still camera having the structure mentioned above, the exposure is calculated at the exposure controller 711 based on the brightness of the image data stored in the capture memory 703, and the brightness of the LCD 741 is controlled by the exposure calculated at the exposure controller 711.

That is, at this conventional electronic still camera, in case that it is judged that image data, whose surroundings of a subject to be taken are dark, are displayed on the LCD 741, the

brightness of the LCD 741 is controlled to make low. With this, the power consumption of the total system is reduced.

Next, a monitor controlling apparatus for an electronic still camera disclosed in the Japanese Patent Application Laid-Open No. HEI 9-93470 is explained. Fig. 4 is a block diagram showing a structure of this monitor controlling apparatus for the electronic still camera disclosed in the Japanese Patent Application Laid-Open No. HEI 9-93470.

As shown in Fig. 4, this monitor controlling apparatus for the electronic still camera consists of an electronic still camera 801, a memory card 823, a hard disk 827, a computer 824, and a TV set 833.

The electronic still camera 801 consists of a system controller 810, an optical block 811, a CCD (solid state image taking device) 812, a CCD driver 813, clock generators 814 and 837, a correlated double sampling sample hold circuit 815 (hereinafter referred to as CDS), an A/D converter 816, a pulse gate circuit 817, a frequency divider 818, an image memory 819, a video digital signal processor 821 (hereinafter referred to as DSP), an interface (I/F) circuit 822, a card connector 825, an external connector 826, a D/A converter 831, a monitor driver 832, a video out connector 834, an LCD driver 835, an LCD 836, and an operating panel 838.

At this electronic still camera 801, operation is executed by either one of two modes, that is, a monitor through mode in which pixel signals obtained through the CCD 812 are displayed on the LCD 836 as a moving image, and a recording mode in which the pixel signals obtained through the CCD 812 are recorded in a recording medium such as the memory card 823 as a still image.

The system controller 810 is a micro computer and controls the total operation of the electronic still camera 801.

The optical block 811 is a lens to take an image, and at the CCD 812, photo diodes (not shown) are formed on its light receiving surface, and further color filters (not shown) are disposed on the photo diodes. Light passed through the optical block 811 enters the light receiving

surface of the CCD 812, and pixel signals corresponding to the subject to be taken are generated on the photo diodes formed on the light receiving surface of the CCD 812.

The CCD 812 outputs the pixel signals generated on the photo diodes to the CDS 815.

The CCD driver 813 drives the CCD 812 synchronized with a clock signal outputting  
5 from the clock generator 814 in a designated cycle. That is, the CCD 812 outputs the pixel signals to the CDS 815 synchronized with the clock signal outputted from the clock generator 814.

The pulse gate circuit 817 outputs a sample hold (S/H) pulse signal to the CDS 815 based on the pulse signal outputted from the clock generator 814. The CDS 815, based on the pulse signal outputted from the pulse gate circuit 817, executes signal processes such as a process to  
10 remove noise from the pixel signals outputted from the CCD 812, and outputs the pixel signals, in which the signal process was executed, to the A/D converter 816.

The frequency divider 818, based on the pulse signal outputted from the clock generator 814, outputs an A/D clock signal to the A/D converter 816. The A/D converter 816, based on the A/D clock signal outputted from the frequency divider 818, applies A/D conversion  
15 to the pixel signals outputted from the CDS 815.

At this monitor controlling apparatus for the electronic still camera, the operation of the CDS 815, the A/D converter 816, the pulse gate circuit 817, and the frequency divider 818 is different between at the monitor through mode and the recording mode. That is, at the A/D converter 816, the cycle of the A/D conversion is different between at the monitor through mode  
20 and the recording mode.

Therefore, the A/D converter 816 applies the A/D conversion to the total pixel signals outputted from the CCD 812 at the recording mode, and applies the A/D conversion to about a half of the total pixel signals outputted from the CCD 812 at the monitor through mode.

The image memory 819 stores the pixel signals applied the A/D conversion at the A/D  
25 converter 816. The DSP 821 executes color processes such as complementary color/primary color

conversion, a white balance process, a gamma correction to the pixel signals stored in the image memory 819 based on a DSP clock signal outputted from the frequency divider 818. And with these processes mentioned above, the DSP 821 generates primary color signals and outputs the generated primary color signals to the I/F circuit 822. The I/F circuit 822 converts the primary color signals outputted from the DSP 821 to a format with which the primary color signals are recorded in the memory card 823 or a format with which the primary color signals are recorded in the hard disk 827 connected to the computer 824.

The memory card 823 is detachable at the card connector 825. And also the computer 824 is detachable at the external connector 826.

The DIA converter 831 converts the primary color signals outputted from the DSP 821 to analog signals. The monitor driver 832 converts the primary color signals converted to the analog signals at the D/A converter 831 to, for example, signals of the NTSC system, and outputs this converted signals to the TV set 833 through the video out connector 834. The LCD driver 835, based on a clock signal outputted from the clock generator 837, applies a process to make the primary color signals outputted from the DSP 821 display on the LCD 836. The LCD 836 displays the pixel signals outputted from the CCD 812 at real time as the moving image at the monitor through mode.

In this, the LCD driver 835 operates based on a clock signal outputted from the clock generator 837 in a designated cycle.

At the operating panel 838, a change-over switch for selecting either one of the monitor through mode and the recording mode is provided.

At this monitor controlling apparatus of the electronic still camera having the structure mentioned above, the cycle for executing the A/D conversion at the A/D converter 816 is made to be different between the monitor through mode and the recording mode. And at the

monitor through mode, the A/D converter 816 applies the A/D conversion to about only a half of the total pixel signals outputted from the CCD 812.

That is, at this monitor controlling apparatus of the electronic still camera, in case that the pixel signals are displayed on the LCD 836, about the half of the total pixel signals are thinned  
5 out at the monitoring through mode, and about the half of the total pixel signals are displayed on the LCD 836. With this, the power consumption of the total system is reduced.

At the electronic still camera, a high definition image quality is required as high as possible for an image recording on a recording medium or an image processed at a personal computer. On the other hand, an image to be displayed on an LCD is not required to be a high  
10 definition image quality, generally, it is sufficient that the image has about 200000 pixels.

However, at the conventional electronic still cameras shown in Figs. 1, 2, and 3, the process to display an image on the LCD is the same as the process making the image record on the recording medium and the process to process the image in the personal computer. Therefore, the power consumption at the process making the image display on the LCD becomes large being  
15 exceeded the necessity.

For example, at an electronic still camera mounted a CCD having about mega-pixels as a solid state image taking device being high definition, an image processing is executed by a high bit number being about 10 bits for the image to be displayed on the LCD.

Especially, at an electronic still camera used an A/D converter whose quantization bit  
20 number is large, the image processing bit number at the DSP disposed at the back stage of the A/D converter becomes large. With this, the size of the circuit becomes large and the power consumption is increased.

At the monitor controlling apparatus of the electronic still camera shown in Fig. 4, at the monitor through mode that the image is displayed on the LCD 836, about the half of the total  
25 pixel signals outputted from the CCD 812 are thinned out. Therefore, the number of pixels of the

image to be displayed on the LCD 836 is thinned out from the number of pixels of the image required a high definition image quality at the structure.

However, at the monitor controlling apparatus of the electronic still camera shown in Fig. 4, after thinned out about the half of the total pixel signals outputted from the CCD 812, at the  
5 DSP 821, a color processing is applied to about the half of the total pixel signals. Consequently, many alias color signals are generated in the image to be displayed on the LCD 836, and there is a problem that the image quality is deteriorated remarkably.

At the DSP 821, generally, the color processing is executed by using plural pixel signals. Therefore, in case that the color processing is executed by using a part of the pixel signals  
10 outputted from the CCD 812, when each of the pixel signals is made to correspond to a subject image to be taken, each of the pixel signals is positioned at the different position on the subject to be taken. Consequently, the correlation among the pixel signals used for the color processing becomes small, and many alias color signals are generated in the image to be displayed on the LCD 836.

## SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide an image taking apparatus that can reduce the power consumption of the total system without deteriorating image quality when an image is displayed on an LCD.

20 According to a first aspect of the present invention for achieving the object mentioned above, there is provided an image taking apparatus. The image taking apparatus provides a solid state image taking device which converts an optical image of a subject to be taken to analog video signals and outputs the analog video signals, an analog to digital (A/D) converter which converts at a designated quantization bit number the analog video signals outputted from the solid state image  
25 taking device to digital video signals having the designated quantization bit number, a digital signal processor (DSP) which applies an image process to the digital video signals outputted from

the A/D converter at a designated signal processing bit number, a displaying apparatus which displays the digital video signals outputted from the DSP, and a recording medium which stores the digital video signals outputted from the DSP. And the designated quantization bit number at the A/D converter is variable.

5           According to a second aspect of the present invention, in the first aspect, the A/D converter makes the quantization bit number in case that the digital video signals are displayed on the displaying apparatus smaller than the quantization bit number in case that the digital video signals are stored in the recording medium.

          According to a third aspect of the present invention, the image taking apparatus  
10 further provides an interface (I/F) circuit which transfers the digital video signals outputted from the DSP to the recording medium in which the digital video signals are recorded, or transfers the digital video signals outputted from the DSP to an external apparatus. And the A/D converter makes the quantization bit number in case that the digital video signals are displayed on the displaying apparatus smaller than the quantization bit number in case that the digital video signals  
15 are transferred to the external apparatus through the I/F circuit.

          According to a fourth aspect of the present invention, in the first aspect, the signal processing bit number at the DSP is variable, and the signal processing bit number is made to be the same bit number of the quantization bit number at the A/D converter in case that the digital video signals are displayed on the displaying apparatus.

20           According to a fifth aspect of the present invention, in the first aspect, the image taking apparatus further provides a mode setting switch for setting an operation mode at the image taking apparatus, and a system controller which generates a bit number converting signal for setting the quantization bit number at the A/D converter and the signal processing bit number at the DSP based on the operation mode set at the mode setting switch, and outputs the bit number  
25 converting signal to the A/D converter and the DSP. And the A/D converter sets the quantization



bit number based on the bit number converting signal outputted from the system controller, and the DSP sets the signal processing bit number based on the bit number converting signal outputted from the system controller.

According to a sixth aspect of the present invention, there is provided an image taking  
5 apparatus. The image taking apparatus provides a solid state image taking device which converts an optical image of a subject to be taken to analog video signals and outputs the analog video signals, an analog to digital (A/D) converter which converts at a designated quantization bit number the analog video signals outputted from the solid state image taking device to digital video signals having the designated quantization bit number, a digital signal processor (DSP) which  
10 applies an image process to the digital video signals outputted from the A/D converter at a designated signal processing bit number, a displaying apparatus which displays the digital video signals outputted from the DSP, and a recording medium which stores the digital video signals outputted from the DSP. And the A/D converter provides plural A/D converting sections in which the quantization bit number of each of the plural A/D converting sections is different between them  
15 and is fixed, and either one of the plural A/D converting sections converts the analog video signals outputted from the solid state image taking device to digital video signals, and outputs the digital video signals to the DSP.

According to a seventh aspect of the present invention, in the sixth aspect, the image taking apparatus further provides a switching circuit which selects one of the plural A/D  
20 converting sections that has smaller quantization bit number than the other of the plural A/D converting sections which is selected at the time when the digital video signals are stored in the recording medium, in case that the digital video signals are displayed on the displaying apparatus. And the digital video signals outputted from the A/D converting section selected by the switching circuit are inputted to the DSP.

According to an eighth aspect of the present invention, in the sixth aspect, the image taking apparatus further provides an interface (I/F) circuit which transfers the digital video signals outputted from the DSP to the recording medium in which the digital video signals are recorded, or transfers the digital video signals outputted from the DSP to an external apparatus. And the  
5 switching circuit, in case that the digital video signals are displayed on the displaying apparatus, selects one of the plural A/D converting sections whose quantization bit number is smaller than the other A/D converting section that is selected at the time when the digital video signals are transferred to an external apparatus through the I/F circuit.

According to ninth aspect of the present invention, in the sixth aspect, the signal  
10 processing bit number at the DSP is variable, and the signal processing bit number in case that the digital video signals are displayed on the displaying apparatus is made to be the same bit number of the quantization bit number at the A/D converting section selected by the switching circuit.

According to tenth aspect of the present invention, in the sixth aspect, the image taking apparatus further provides a mode setting switch for setting an operation mode at the image  
15 taking apparatus, and a system controller which generates an A/D converting section changing signal for switching the switching circuit based on the operation mode set by the mode setting switch and outputs the generated A/D converting section changing signal to the switching circuit, and also generates a bit number converting signal for setting the signal processing bit number at the DSP based on the operation mode set at the mode setting switch, and outputs the bit number  
20 converting signal to the DSP. And the switching circuit selects either one of the plural A/D converting sections based on the A/D converting section changing signal outputted from the system controller, and the DSP sets the signal processing bit number based on the bit number converting signal outputted from the system controller.

According to an eleventh aspect of the present invention, the system controller, in case that the digital video signals stored in the recording medium are displayed on the displaying apparatus, stops operation of the solid state image taking device, the A/D converter, and the DSP.

According to a twelfth aspect of the present invention, the mode setting switch, in  
5 case that the digital video signals have been stored in the recording medium, selects whether the digital video signals stored in the recording medium are made to display on the displaying apparatus or not.

According to a thirteenth aspect of the present invention, the image taking apparatus further provides a displaying apparatus driver for making the digital video signals display on the  
10 displaying apparatus by thinning out a part of the digital video signals outputted from the DSP.

According to a fourteenth aspect of the present invention, the image taking apparatus is an electronic still camera.

According to the present invention, the quantization bit number at the A/D converter is variable. Therefore, in case that a monitoring image is displayed on the displaying apparatus,  
15 when the quantization bit number at the A/D converter is controlled to be smaller than that at the time when the digital video signals are stored in the recording medium or are transferred to the external apparatus, the power consumption at the A/D converter can be reduced.

According to the present invention, in case that the signal processing bit number at the DSP is variable, when the monitoring image is displayed on the displaying apparatus, by setting  
20 the signal processing bit number at the DSP to equal to the quantization bit number at the A/D converter, the power consumption at the DSP can be reduced. And at the back stage of the A/D converter, plural DSPs corresponding to the quantization bit number that changes at the A/D converter are not needed to provide. With this, the circuit size of the total system of the image taking apparatus can be prevented to become large.

According to the present invention, in case that the monitoring image is displayed on the displaying apparatus, the power consumption at the A/D converter and the DSP can be reduced, and also the circuit size of the total system of the image taking apparatus can be prevented to become large. Therefore, the power consumption of the total system of the image taking  
5 apparatus can be reduced largely.

According to the present invention, in case that the monitoring image is displayed on the displaying apparatus, after that image processes are applied to the video signals outputted from the solid state image taking device at the DSP, a thinning out image process, in which a part of the video signals is thinned out at a driver for the displaying apparatus, is applied to the video signals.  
10 Therefore, the generation of color alias signals can be restrained and the deterioration of the image quality can be restrained.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The objects and features of the present invention will become more apparent from the  
15 consideration of the following detailed description taken in conjunction with the accompanying drawings in which:

Fig. 1 is a block diagram showing a structure of a conventional electronic still camera disclosed in Japanese Patent Application LaidOpen No. HEI 11-164 178;

Fig. 2 is a block diagram showing a structure of a conventional electronic still camera  
20 disclosed in Japanese Patent Application LaidOpen No. HEI 11-136551;

Fig. 3 is a block diagram showing a structure of a conventional electronic still camera disclosed in Japanese Patent Application Laid-Open No. HEI 10-2 76356;

Fig. 4 is a block diagram showing a structure of a monitor controlling apparatus for an electronic still camera disclosed in Japanese Patent Application Laid-Open No. HEI 9-93470;

Fig. 5 is a block diagram showing a structure of a first embodiment of an image taking  
25 apparatus of the present invention;

Fig. 6 is a diagram showing a structure of a digital signal processor of the first embodiment of the image taking apparatus of the present invention;

Fig. 7A is a diagram showing an operation sequence at a taking image mode of the first embodiment of the image taking apparatus of the present invention;

5 Fig. 7B is a diagram showing an operation sequence at a PC displaying mode of the first embodiment of the image taking apparatus of the present invention;

Fig. 7C is a diagram showing an operation sequence at a reproducing mode of the first embodiment of the image taking apparatus of the present invention; and

10 Fig. 8 is a block diagram showing a structure of a second embodiment of the image taking apparatus of the present invention.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, embodiments of the present invention are explained in detail. Fig. 5 is a block diagram showing a structure of a first embodiment of an image taking  
15 apparatus of the present invention.

As shown in Fig. 5, the first embodiment of the image taking apparatus of the present invention consists of a lens 1, a diaphragm 2, a shutter 3, a solid state image taking device (CCD) 4, an analog signal processor 5, a horizontal/vertical (H/V) driver 6, a diaphragm/shutter controller 7, an A/D converter 8, a digital signal processor (DSP) 9, a frame memory 10, an LCD driver 11,  
20 an interface (I/F) circuit 12, a timing generator (TG) 13, a system controller (hereinafter referred to as CPU) 14, an LCD 15, a recording medium 16, a mode setting switch 19.

[[At]] In the first embodiment of the present invention, any one of a taking image mode, a reproducing mode, and a personal computer (PC) displaying mode is selected at the mode setting switch 19.

25 In this, the taking image mode is, generally, an LCD displaying mode in which video signals taken at the solid state image taking device 4 are displayed on the LCD 15 [[as]] in a

monitoring image[[,]] ~~and when~~ . When the shutter 3 is pushed at the LCD displaying mode, the taking image mode becomes a recording mode in which video signals taken at the solid state image taking device 4 are recorded in the recording medium 16.

The reproducing mode signifies that the video signals recorded in the recording  
5 medium 16 are reproduced and displayed on the LCD 15, and the PC displaying mode signifies that the video signals taken at the solid state image taking device 4 are transferred to a PC (not shown).

The CPU 14, based on the selected mode at the mode setting switch 19 and an operated result of the video signals at the DSP 9, controls all functions in the image taking  
10 apparatus. For example, the CPU 14 sets a quantization bit number at the A/D converter 8, and calculates various kinds of parameters at the DSP 9 and sets a signal processing bit number for changing of signal processing of the video signals at the DSP 9, and controls the TG 13 and the diaphragm/shutter controller 7 so that an optimum image taking condition can be obtained.

The TG 13 outputs a clock signal in a designated cycle to the H/V driver 6, the analog  
15 signal processor 5, and the A/D converter 8, based on an instruction from the CPU 14.

The diaphragm/shutter controller 7 controls the diaphragm 2 and the shutter 3 based on an instruction from the CPU 14, and makes an optical image of a subject to be taken obtained at the lens 1 project to the solid state image taking device 4 by adjusting the distance to the optical image of the subject to be taken and the amount of light of the optical image of the subject to be  
20 taken to desired values.

The H/V driver 6 outputs a driving pulse to the solid state image taking device 4 by synchronized with the clock signal outputted from the TG 13 in a designated cycle.

The solid state image taking device 4 is a CCD in which a color filter array (not shown) is disposed in a designated arrangement on photoelectric conversion elements (not shown)  
25 arranged in two dimensions. When an optical image of a subject to be taken is projected on the

photoelectric conversion elements, this optical image of the subject to be taken is converted to video signals being electric analog signals, for example, corresponding to each color of red (R), green (G), and blue (B).

And the solid state image taking device 4 provides horizontal/vertical registers (not shown) which output the video signals that the optical image of the subject to be taken was converted by the photoelectric conversion elements, based on the driving pulse outputted from the H/V driver 6. With this, the solid state image taking device 4 outputs the video signals by synchronized with the clock signal outputted from the TG 13. The analog signal processor 5 removes noise ~~such as~~ e.g. reset noise and shot noise, caused by dark current, which are included in the video signals outputted from the solid state image taking device 4~~[[,]]~~ by ~~synch~~synchronizing with the clock signal outputted from the TG 13, and outputs the video signals in which the noise ~~[[was]]~~ is removed.

The A/D converter 8 converts the video signals outputted from the analog signal processor 5 to digital video signals by a designated quantization bit number ~~by~~ synchronized with the clock signal outputted from the TG 13, and outputs the digital video signals to the DSP 9. In this, the quantization bit number is variable at the A/D converter 8, and the quantization bit number is changed by a bit number converting signal 17 outputted from the CPU 14.

~~[[At]]~~ In the first embodiment of the present invention, the solid state image taking device 4, the analog signal processor 5, and the A/D converter 8 are operated ~~by~~ synchronized with the clock signal outputted from the TG 13. With this, all the video signals outputted from the solid state image taking device 4 are converted to the digital video signals at the A/D converter 8 by the designated quantization bit number.

Fig. 6 is a diagram showing a structure of the DSP 9 of the first embodiment of the image taking apparatus of the present invention. As shown in Fig. 6, the DSP 9 consists of a color

separation circuit 201, a color correction circuit 202, a white balance circuit 203, a contour compensation circuit 204, a gamma correction circuit 205, and a clip circuit 206.

The color separation circuit 201 applies a color interpolation process (color process) to the digital video signals outputted from the A/D converter 8 and converts the video signals outputted from the A/D converter 8 to color video signals and outputs the color video signals. For example, when video signals corresponding to R, G, and B are outputted from the solid state image taking device 4, at the color separation circuit 201, the video signals outputted from the A/D converter 8 are converted to color video signals composed of a R signal, a G signal, and a B signal.

The color correction circuit 202 applies a linear matrix process to the color video signals outputted from the color separation circuit 201 in order to improve the color reproducibility. And the white balance circuit 203 adjusts a gain of the color video signals applied the linear matrix process at the color correction circuit 202 so that a designated color reproducibility can be always kept regardless of the lightning condition at the image taking.

The contour compensation circuit 204 compensates contours of the color video signals whose gain were adjusted at the white balance circuit 203 in order to improve the sharpness of the image. And the gamma correction circuit 205 applies a non-linear process to the color video signals whose contours were compensated at the contour compensation circuit 204 in order to meet input and output characteristics of the LCD 15.

The clip circuit 206 removes color video signals that did not reach a designated gradation level from the color video signals applied the non-linear process at the gamma correction circuit 205.

The DSP 9 applies the various image processes mentioned above by the designated signal processing bit number to the color video signals outputted from the A/D converter 8 and outputs color video signals generated at the image processes mentioned above. In this, the signal processing bit number at the DSP 9 changes based on the bit number converting signal 17 supplied



from the CPU 14, and is set to be the same bit number that the quantization bit number at the A/D converter 8.

At In the first embodiment of the present invention, the bit number converting signal 17 outputted from the CPU 14 is directly inputted to the A/D converter 8 and the DSP 9. However, 5 the bit number converting signal 17 outputted from the CPU 14 can be inputted to the A/D converter 8 and the DSP 9 through an internal bus 18.

The color video signals outputted from the DSP 9 are inputted to the LCD driver 11, the I/F circuit 12, the frame memory 10, and the CPU 14 through the internal bus 18.

The frame memory 10 stores the color video signals outputted from the DSP 9 10 temporarily and outputs the color video signals to the LCD driver 11, the I/F circuit 12, and the CPU 14 corresponding to the necessity.

The LCD driver 11 applies a process, in which these color video signals are made to display on the LCD 15, to the color video signals outputted from the DSP 9 and makes the color video signals applied the process display on the LCD 15.

15 Generally, the number of pixels of the video signals outputted from the solid state image taking device 4 is larger than the number of pixels required to display on the LCD 15. Therefore, the processes at the LCD driver 11 include a process to thin out a part of data of the color video signals outputted from the DSP 9.

At In the Japanese Patent Application Laid-Open No. HEI 9-93470, the color 20 interpolation process is applied to video signals thinned out from the video signals outputted from the solid state image taking device 4. Therefore the color alias signals are generated largely, as a result, the image quality is deteriorated remarkably.

However, at the first embodiment of the present invention, the color interpolation process is executed at the color separation circuit 201 provided in the DSP 9 for all the video 25 signals outputted from the solid state image taking device 4. After this, the thinning out process of

the color video signals is executed at the LCD driver 11. Therefore, the generation of the color alias signals can be restrained and the deterioration of the image quality can be prevented.

The I/F circuit 12 is an interface circuit executing a process that makes the color video signals outputted from the DSP 9 record in the recording medium 16 ~~such as, e.g.~~ a memory card,  
5 a hard disk, ~~and or~~ a magnetic tape.

~~At~~ In the first embodiment of the present invention, the I/F circuit 12 can be used as not only an interface circuit to record the color video signals in the recording medium 16 but also as an external bus interface circuit connecting to a PC and a printer, for example, as an IEEE 1394,  
a u

universal serial bus (USB), and a small computer system interface (SCSI).

Next, referring to drawings, operation of the first embodiment of the image taking apparatus of the present invention is explained. Fig. 7A is a diagram showing an operation sequence at the taking image mode of the first embodiment of the image taking apparatus of the present invention. Fig. 7B is a diagram showing an operation sequence at the PC displaying mode  
15 of the first embodiment of the image taking apparatus of the present invention. Fig. 7C is a diagram showing an operation sequence at the reproducing mode of the first embodiment of the image taking apparatus of the present invention.

First, the operation sequence at the taking image mode shown in Fig. 7A is explained. After the power (not shown) is turned on, ~~when~~ and the taking image mode is selected ~~at the mode setting switch 19,~~ at the functions in the image taking apparatus, ~~in order that a photographer is made to monitor a subject to be taken,~~ operation of a LCD displaying mode displaying a monitoring image on the LCD 15 is executed so that a photographer can monitor a subject.  
20

In this, even after the taking image mode is selected at the mode setting switch 19, when the power is turned on, at the functions in the image taking apparatus, the operation of the  
25 LCD displaying mode displaying the monitoring image on the LCD 15 is executed.

When the taking image mode is selected at the mode setting switch 19, the CPU 14 outputs the bit number converting signal 17, with which the quantization bit number at the A/D converter 8 and the signal processing bit number at the DSP 9 are set to be 8 bits, to the A/D converter 8 and the DSP 9. With this, the quantization bit number at the A/D converter 8 and the signal processing bit number at the DSP 9 are set to be 8 bits.

The CPU 14 controls the TG 13 and the diaphragm/shutter controller 7 at the same time of outputting the bit number converting signal 17. With this, the TG 13 outputs a clock signal in a designated cycle, and the diaphragm/shutter controller 7 controls the diaphragm 2 and the shutter 3.

By controlling the diaphragm 2 and the shutter 3 at the diaphragm/shutter controller 7, the distance and the amount of light of the optical image of the subject to be taken obtained at the lens 1 are adjusted to required values and the adjusted optical image is projected on the solid state image taking device 4.

At the solid state image taking device 4, the optical image of the subject to be taken is projected on the surface of the photoelectric conversion elements provided in the solid state image taking device 4. And this optical image of the subject to be taken is converted to video signals being analog electric signals by the photoelectric conversion elements.

At this time, at the H/V driver 6, driving pulses are generated by ~~synch~~synchronizing with the clock signal outputted from the TG 13 in a designated cycle. And the generated driving pulses are outputted to the H/V registers provided in the solid state image taking device 4.

With this, at the solid state image taking device 4, the H/V registers provided in the solid state image taking device 4 output the video signals ~~by~~ synchronized with the driving pulses outputted from the H/V drivers 6.

Next, at the analog signal processor 5, noise included in the video signals outputted from the solid state image taking device 4 is removed ~~by~~ synchronized with the clock signal outputted from the TG 13, and the video signals from which the noise was removed are outputted to the A/D converter 8. At the A/D converter 8, the quantization bit number has been set to be 8 bits  
5 by the bit number converting signal 17 outputted from the CPU 14. With this, the video signals outputted from the analog signal processor 5 are converted to the video signals of 8 bits ~~synchronized~~by synchronizing with the clock signal outputted from the TG 13 in a designated cycle, and the converted 8 bits video signals are outputted to the DSP 9.

At the DSP 9, first, at the color separation circuit 201, the color interpolation process  
10 (color process) is applied to the digital video signals outputted from the A/D converter 8. With this, the video signals outputted from the A/D converter 8 are converted to color video signals.

After this, the linear matrix process is applied to the color video signals, which were applied the color interpolation process at the color separation circuit 201, at the color correction circuit 202. And the gain of the color video signals is adjusted at the white balance circuit 203.  
15 And, the contour of the image of the color video signals is compensated at the contour compensation circuit 204, and after this the non-linear process is applied to the color video signals outputted from the contour compensation circuit 204 at the gamma correction circuit 205.

~~And at~~At the clip circuit 206, the color video signals that did not reach a designated gradation level are removed from the color video signals applied to the non-linear process at the  
20 gamma correction circuit 205.

At the DSP 9, the signal processing bit number has been set to be 8 bits, as the same as the quantization bit number at the A/D converter 8, by the bit number converting signal 17 outputted from the CPU 14. With this, various image processes mentioned above are applied to the video signals outputted from the A/D converter 8 at 8 bits, and the color video signals generated by  
25 the various image processes are outputted from the DSP 9.

The color video signals outputted from the DSP 9 are inputted to the LCD driver 11, the I/F circuit 12, the frame memory 10, and the CPU 14 through the internal bus 18.

After this, at the LCD driver 11, processes including a part of the color video signals thinning out process so that this color video signals are displayed on the LCD 15 are applied to this  
5 color video signals outputted from the DSP 9. With this, the color video signals being the monitoring image are displayed on the LCD 15.

At this time, when the photographer pushes the shutter 3 by specified a subject to be taken, a recording mode, which records an optical image of the subject to be taken projected on the solid state image taking device 4 at the time when the shutter 3 was pushed in the recording  
10 medium 16, is executed, at the functions provided in the image taking apparatus.

At the recording mode, first, the CPU 14 outputs a bit number converting signal 17, which changes the quantization bit number at the A/D converter 8 and the signal processing bit number at the DSP 9 to 10 bits, to the A/D converter 8 and the DSP 9. With this, the quantization bit number at the A/D converter 8 and the signal processing bit number at the DSP 9 are changed to  
15 10 bits respectively.

Next, at the solid state image taking device 4, the optical image of the subject to be taken projected on the surface of the photoelectric conversion elements at the time when the shutter 3 was pushed is converted to video signals ~~being analog electric signals, which are analog electric signals,~~ by the photoelectric conversion elements and the converted video signals are then  
20 outputted.

Next, at the analog signal processor 5, noise including in the video signals outputted from the solid state image taking device 4 is removed by synchronized with the clock signal outputted from the TG 13, and the video signals ~~whose~~ with noise ~~was~~ removed are outputted to the A/D converter 8. At the A/D converter 8, the quantization bit number has been set to be 10 bits  
25 by the bit number converting signal 17 outputted from the CPU 14. With this, the video signals

outputted from the analog signal processor 5 are converted to video signals of 10 bits by ~~synch~~synch~~ronized~~ronizing with the clock signal outputted from the TG 13, and the converted video signals are outputted to the DSP 9.

At the DSP 9, the signal processing bit number has been set to be 10 bits ~~that~~, which  
5 is the same as the quantization bit number at the A/D converter 8, by the bit number converting signal 17 outputted from the CPU 14. With this, ~~an~~ image processing of 10 bits is applied to the video signals outputted from the A/D converter 8, and color video signals are generated and outputted.

The color video signals outputted from the DSP 9 are inputted to the LCD driver 11,  
10 the I/F circuit 12, the frame memory 10, and the CPU 14 through the internal bus 18.

At the I/F circuit 12, a process to record ~~this~~these color video signals in the recording medium 16 is applied to the color video signals outputted from the DSP 9, and the color video signals are recorded in the recording medium 16.

~~At~~In the first embodiment of the present invention, at the recording mode that the  
15 color video signals are recorded in the recording medium 16, it is possible that the color video signals that are being recorded in the recording medium 16 are displayed on the LCD 15. ~~In this, in case that~~If the color video signals that are being recorded in the recording medium 16 are displayed on the LCD 15, the color video signals displaying on the LCD 15 become the color video signals processed at 10 bits at the A/D converter 8 and the DSP 9.

20 ~~And at~~Also in the first embodiment of the present invention, at the recording mode, it is possible that the photographer selects whether the color video signals that are being recorded in the recording medium 16 are displayed on the LCD 15 or not by using the mode setting switch 19.

When recording the color video signals in the recording medium 16 is completed, in order to take a ~~next~~another image, the CPU 14 outputs a bit number converting signal 17, which  
25 changes the quantization bit number at the A/D converter 8 and the signal processing bit number at

the DSP 9 to 8 bits again, to the A/D converter 8 and the DSP 9. With this, the quantization bit number at the A/D converter 8 and the signal processing bit number at the DSP 9 are changed to 8 bits respectively. This signifies that the mode returns the LCD displaying mode.

Next, the operation sequence at the PC displaying mode shown in Fig. 7B is explained. In this, the operation is explained below. After power is turned on, a taking image mode is selected at the mode setting switch 19 and a monitoring image is displayed on the LCD 15. ~~And the~~ The PC displaying mode is also selected at the mode setting switch 19 ~~during the~~ when the monitoring image is ~~displaying~~ displayed on the LCD 15. In case that the PC displaying mode is directly selected at the mode setting switch 19 without selecting the taking image mode, the equivalent operation is executed.

When the PC displaying mode is selected ~~during when~~ the monitoring image is ~~displaying~~ displayed on the LCD 15, at the functions of the image taking apparatus of the present invention, image data of color video signals are transferred to a personal computer (PC) (not shown) through the I/F circuit 12.

The CPU 14 controls the LCD driver 11 through the internal bus 18 so that the LCD 15 becomes off, with this, the LCD 15 is turned off.

In this, in case that the monitoring image is displaying on the LCD 15, the quantization bit number at the A/D converter 8 and the signal processing bit number at the DSP 9 are 8 bits respectively.

Therefore, the CPU 14 outputs the bit number converting signal 17, which changes the quantization bit number at the A/D converter 8 and the signal processing bit number at the DSP 9 to 10 bits, to the A/D converter 8 and the DSP 9, at the same time of controlling the LCD driver 11. With this, the quantization bit number at the A/D converter 8 and the signal processing bit number at the DSP 9 are changed to 10 bits respectively.

After this, in the functions in the image taking apparatus of the present invention, at the PC displaying mode, the same operation as the recording mode at the taking image mode shown in Fig. 7A, is executed until the color video signals are outputted from the DSP 9.

In this, the color video signals outputted from the DSP 9 are color video signals  
5 processed at that the quantization bit number at the A/D converter 8 and the signal processing bit number at the DSP 9 are 10 bits respectively.

At the I/F circuit 12, the color video signals outputted from the DSP 9 are converted to a format being able to be processed at the PC and the converted color video signals are transferred to the PC.

10 Therefore, at the PC displaying mode, the I/F circuit 12 works as an external bus interface to the PC or a printer.

Next, the operation sequence at the reproducing mode shown in Fig. 7C is explained. When the reproducing mode is selected at the mode setting switch 19, at the functions of the image taking apparatus of the present invention, operation is executed at the state that the quantization bit  
15 number at the A/D converter 8 and the signal processing bit number at the DSP 9 are 10 bits respectively, as the same as at the recording mode shown in Fig. 7A, and the PC displaying mode shown in Fig. 7B. ~~And a~~ A process to display the color video signals, stored in ~~such as, e.g.,~~ the recording medium 16, the frame memory 10, ~~and or~~ a hard disk (not shown) in the PC, on the LCD  
15 by ~~reproducing-reproduction~~ is executed. In this, a case[[,]] in which the color video signals  
20 stored in the recording medium 16 are reproduced and displayed on the LCD 15[[,]] is explained. ~~At a case in which~~ When the color video signals stored in the frame memory 10 or the hard disk of the PC are reproduced and displayed on the LCD 15, the equivalent operation is also executed.

The internal bus 18 is controlled by the CPU 14, and the color video signals stored in the recording medium 16 are read out through the I/F circuit 12, and the read out color video  
25 signals are transferred to the LCD driver 11.



At the LCD driver 11, processes including a thinning out process, in which a part of the color video signals is thinned out to display the color video signals on the LCD 15, is applied to the color video signals transferred from the recording medium 16. With this process, the color video signals stored in the recording medium 16 are reproduced and displayed on the LCD 15.

5 As mentioned above, at the reproducing mode, the color video signals are reproduced and displayed on the LCD 15, ~~at the~~ in a state that where the solid state image taking device 4, the analog signal processor 5, the A/D converter 8, and the DSP 9 ~~are do not made to work~~.

~~At In~~ the reproducing mode, the first embodiment of the present invention has a structure that the operation at the solid state image taking device 4, the analog signal processor 5,  
10 the A/D converter 8, and the DSP 9 is stopped by the CPU 14. Therefore, the power consumption of the functions not related to the operation ~~at of~~ the reproducing mode can be reduced.

Further, ~~at in~~ the reproducing mode of the first embodiment of the present invention, the changing operation, in which the quantization bit number at the A/D converter 8 and the signal processing bit number at the DSP 9 are changed, is not needed[~~], therefore~~]. Therefore, the bit  
15 number converting signal 17 is not outputted from the CPU 14.

~~At In~~ the first embodiment of the present invention, as an example of the operation sequences, the operation sequences shown in Figs. 7A, 7B, and 7C are explained, however, the other operation sequences can be used within the scope and spirit of the present invention.

As mentioned ~~at in~~ the first embodiment of the present invention, the quantization bit  
20 number at the A/D converter 8 is variable. Therefore, at the LCD displaying mode, the power consumption at the A/D converter 8 can be reduced by that the quantization bit number at the A/D converter 8 is controlled to reduce.

Further, the signal processing bit number at the DSP 9 is variable[~~], therefore, at~~  
Therefore, in the LCD displaying mode, the power consumption at the DSP 9 can be reduced ~~by~~  
25 ~~that because~~ the signal processing bit number at the DSP 9 is reduced to the equivalent number of the quantization bit number at the A/D converter 8. Moreover, at the back stage of the A/D

converter 8, plural DSPs are not needed to provide corresponding to the changing quantization bit number at the A/D converter 8. Therefore, the circuit size of the total system of the image taking apparatus is not made to be large.

As mentioned above, at the LCD displaying mode, the power consumption at the A/D converter 8 and the DSP 9 is reduced[[,]]. ~~and also~~ Also, the circuit size of the total system of the image taking apparatus is not made to be large[[,]]. ~~therefore~~ Therefore, the power consumption of the total system of the image taking apparatus is largely reduced.

~~And at~~ In the LCD displaying mode, ~~in case that~~ when the amount of data of the video signals outputted from the solid state image taking device 4 is reduced, after the color interpolation process is applied to all the video signals outputted from the solid state image taking device 4 at the DSP 9, a thinning out process, ~~that where~~ a part of all the video signals is thinned out, is applied at the LCD driver 11. With this process, the generation of color alias signals is restrained, and the deterioration of the image quality of the image displaying on the LCD 15 can be prevented.

Next, referring to a drawing, a second embodiment of the image taking apparatus of the present invention is explained. Fig. 8 is a block diagram showing a structure of the second embodiment of the image taking apparatus of the present invention.

[[At]] In the second embodiment, ~~a function that is equivalent to the function at functions in the first embodiment has~~ have the same reference number in the second embodiment that the first embodiment has. As shown in Fig. 8, [[at]] in the second embodiment of the image taking apparatus of the present invention, A/D converters 20, and 21 are provided instead of the A/D converter 8 [[at]] in the first embodiment, and a switching circuit 22 is ~~newly~~ added. Each of the A/D converters 20 and 21 provides a fixed quantization bit number being different between them respectively. The switching circuit 22 selects one of the A/D converters 20 and 21.

[[At]] In the second embodiment of the present invention, the quantization bit number at the A/D converter 20 is set to be 10 bits, and the quantization bit number at the A/D converter 21 is set to be 8 bits.

The CPU 14 outputs an A/D converter changing signal 23 to the switching circuit 22 for making the switching circuit 22 switch, and controls the switching circuit 22 by this A/D converter changing signal 23.

5 The second embodiment of the present invention has a structure that the A/D converter changing signal 23 outputted from the CPU 14 is directly inputted to the switching circuit 22. However, the A/D converter changing signal 23 outputted from the CPU 14 can be inputted to the switching circuit 22 through the internal bus 18.

Operation of the second embodiment of the image taking apparatus of the present invention is explained.

10 At the LCD displaying mode, the CPU 14 outputs the A/D converter changing signal 23 for connecting the analog signal processor 5 and the A/D converter 21 to the switching circuit 22, and also outputs the bit number converting signal 17 for changing the signal processing bit number at the DSP 9 to 8 bits being equivalent to the quantization bit number at the A/D converter 21.

15 With this operation, the switching circuit 22 is changed over, and the analog signal processor 5 and the A/D converter 21 are connected[[,]]. ~~and the~~The signal processing bit number at the DSP 9 is set to 8 bits being equivalent to the quantization bit number at the A/D converter 21.

After this, at the A/D converter 21, the video signals outputted from the analog signal processor 5 are converted to the video signals being 8 bits and the 8 bit video signals are outputted.  
20 And at the DSP 9, an image process is applied to the video signals outputted from the A/D converter 21 at 8 bits.

At the recording mode and the PC displaying mode, the CPU 14 outputs the A/D converter changing signal 23 for connecting the analog signal processor 5 and the A/D converter 20 to the switching circuit 22, and also outputs the bit number converting signal 17 for changing  
25 the signal processing bit number at the DSP 9 to 10 bits being equivalent to the quantization bit number at the A/D converter 20.

With this operation, the switching circuit 22 is changed over, and the analog signal processor 5 and the A/D converter 20 are connected, and the signal processing bit number at the DSP 9 is set to 10 bits being equivalent to the quantization bit number at the A/D converter 20.

After this, at the A/D converter 20, the video signals outputted from the analog signal processor 5 are converted to the video signals being 10 bits and the 10 bit video signals are outputted. ~~And at~~ At the DSP 9, an image process is applied to the video signals outputted from the A/D converter 20 at 10 bits.

As mentioned above, at the second embodiment of the present invention, the structure, in which the video signals outputted from the analog signal processor 5 are converted to digital video signals, is only different from the first embodiment. And the other functions and operation are the same that the first embodiment has, therefore, the detailed explanation is omitted. And at the second embodiment, operation at the reproducing mode is the same as the first embodiment.

At the first and second embodiments of the present invention, the structure and operation are explained as that the image taking apparatus is the electronic still camera[[,]] ~~however-However~~, the image taking apparatus of the present invention can be also applied to the other apparatuses not be the electronic still camera.

~~And at~~ Also in the first and second embodiments of the present invention, the structure and operation of the displaying apparatus for displaying images is explained as that the displaying apparatus is an LCD. However, the other displaying apparatuses not be the LCD can be also used as the displaying apparatus at the present invention.

~~And at~~ Also in the first and second embodiments of the present invention, the cases[[,]] in which the quantization bit number at the LCD displaying mode is set to be 8 bits and the quantization bit number at the recording mode and the PC displaying mode is set to be 10 bits[[,]] are explained. However, ~~[[at]]~~ in the present invention, the quantization bit number at the LCD displaying mode can be set to be an arbitrary number at the condition that the quantization bit

number at the LCD displaying mode is smaller than that at the recording mode and the PC displaying mode.

~~And at~~ In the first and second embodiments of the present invention, a structure, in which an analog process such as removing noise at an analog signal processor is applied to video signals outputted from a solid state image taking device and after this analog to digital conversion is applied to the video signals at an A/D converter, is explained. However, at the present invention, a structure, in which first the analog to digital conversion is applied to the video signals outputted from the solid state image taking device at an A/D converter and after this the digital process such as removing noise at an DSP is applied to the video signals, can be used.

As mentioned above, according to the present invention, the quantization bit number at an A/D converter is variable. Therefore, in case that a monitoring image is displayed on a displaying apparatus being at a displaying mode, when the quantization bit number at the A/D converter is controlled to be smaller than that at a recording mode or a PC displaying mode, the power consumption at the A/D converter can be reduced.

And in case that the signal processing bit number at a DSP is variable, when a monitoring image is displayed on a displaying apparatus, by setting the signal processing bit number at the DSP to equal to the quantization bit number at the A/D converter, the power consumption at the DSP can be reduced. And at the back stage of the A/D converter, plural DSPs corresponding to the quantization bit number that changes at the A/D converter are not needed to provide. With this, the circuit size of the total system of the image taking apparatus can be prevented to become large.

As mentioned above, in case that the monitoring image is displayed on the displaying apparatus, the power consumption at the A/D converter and the DSP can be reduced, and also the circuit size of the total system of the image taking apparatus can be prevented to become ~~from~~ from

becoming large. Therefore, the power consumption of the total system of the image taking apparatus can be reduced largely.

And in case that the monitoring image is displayed on the displaying apparatus, after that image processes are applied to the video signals outputted from the solid state image taking  
5 device at the DSP, a thinning out image process, in which a part of the video signals is thinned out at a driver for the displaying apparatus, is applied to the video signals. Therefore, the generation of color alias signals can be restrained and the deterioration of the image quality can be restrained.

While the present invention has been described with reference to the particular illustrative embodiments, it is not to be restricted by those embodiments but only by the appended  
10 claims. It is to be appreciated that those skilled in the art can change or modify the embodiments without departing from the scope and spirit of the present invention.